

A territory-wide study on the impact of COVID-19 on diabetes-related acute care

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ABSTRACT

Diabetes is a risk factor for the severity of coronavirus disease 2019 (COVID-19). Little is known how the COVID-19 pandemic has disrupted diabetes-related acute care. We compared hospitalization rates for severe hyperglycemia or hypoglycemia during the COVID-19 outbreak in Hong Kong (study period: 25 January to 24 April 2020) with those during 25 January to 24 April 2019 (inter-year control) and 25 October 2019 to 24 January 2020 (intra-year control), using Poisson regression analysis. Hospitalization rates abruptly decreased after the first confirmed local COVID-19 case on 23 January 2020, by 27% and 23% compared with the inter-year and intra-year control periods, respectively (incidence rate ratio 0.73 and 0.77, $P < 0.001$). Hospitalizations were reduced for severe hyperglycemia and hypoglycemia, but not diabetic ketoacidosis. This significant reduction in hospitalization rates should alert endocrinologists to take proactive measures to optimize glycaemic control of individuals with diabetes.

INTRODUCTION

The coronavirus disease 2019 (COVID-19) pandemic has overwhelmed healthcare systems globally¹, with COVID-19 patients with diabetes having worse outcomes². Hong Kong was one of the first regions involved³. After the first confirmed local case on 23 January 2020, the Hong Kong Hospital Authority (HA) implemented the Emergency Response Level on 25 January 2020⁴. Little is known about how the COVID-19 pandemic has disrupted diabetes-related acute care. We compared the hospitalization rates for severe hyperglycemia or hypoglycemia before and during the COVID-19 outbreak in Hong Kong.

METHODS

We carried out a retrospective study using data extracted from the territory-wide anonymized electronic health records of the HA, the Clinical Data Analysis and Reporting System. The HA is the only public-funded healthcare provider in Hong Kong, covering 90% of all secondary and tertiary care in the territory⁵. Accident and Emergency (A&E) services are provided at 18 public hospitals under the HA, distributed among seven clusters⁶. Our institution, Queen Mary Hospital, provided A&E services in the Hong Kong West Cluster, serving a population of 530,000⁷. The study period was from 25 January to 24 April 2020. A similar period in the previous year (25 January to 24

April 2019) was used as the inter-year control. The preceding 3 months (25 October 2019 and 24 January 2020) was used as the intra-year control. Principle diagnoses from discharge records were retrieved using the following International Classification of Diseases, Ninth revision codes. Severe hyperglycemia, including symptomatic hyperglycemia and hyperosmolar hyperglycemic state, was defined by 250.82–83, 250.20 and 250.22–23. Diabetic ketoacidosis (DKA) was defined by 250.10, 250.12–13 and 250.30–33. Severe hypoglycemia was defined by 250.80–81 and 251.0–2 with concomitant prescription of insulin or sulfonylurea before admission. All adults admitted with the above principle diagnoses to the 18 hospitals under the HA were included. For validation, 613 records admitted to Queen Mary Hospital for severe hyperglycemia or hypoglycemia from 1 January 2019 to 24 April 2020 reviewed in a hospital audit of emergency admissions showed a good accuracy in identifying hospitalizations for severe hyperglycemia (94.2%, 229/243 records), DKA (100%, 23/23 records) and severe hypoglycemia (93.1%, 323/347 records). The admission criteria from A&E generally followed the hospital admission guidelines by the American Diabetes Association⁸. Clinical characteristics including age, sex, plasma glucose, recent glycated hemoglobin (HbA1c) within 6 months of admission and baseline medications including antidiabetic agents were captured. Hospitalization rates were calculated by the total number of hospitalizations during the defined period divided by the

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Table 1 | Characteristics of patients admitted during the study and the control periods

	Study period	Inter-year control	Intra-year control
Severe hyperglycemia			
No. hospitalizations	531	789	756
No. hospitalizations per day	5.8	8.8	8.2
Incidence rate ratio (95% CI)			
Compared with inter-year control	0.66 (0.60–0.74)***	—	—
Compared with intra-year control	0.71 (0.63–0.79)***	—	—
Age (years)	67.5 ± 16.2	66.8 ± 16.1	66.3 ± 16.3
Sex (% female)	41.4%	41.6%	44.7%
Duration of diabetes (years)	17.0 (10.0–24.0)	12.0 (4.0–20.0)**	15.0 (7.0–22.0)**
Recent HbA1c (%)	11.3 (9.5–13.6)	11.1 (9.2–12.9)*	11.0 (9.2–12.9)**
Diabetic ketoacidosis			
No. hospitalizations	96	95	118
No. hospitalizations per day	1.1	1.1	1.3
Incidence rate ratio (95% CI)			
Compared with inter-year control	1.00 (0.74–1.34)	—	—
Compared with intra-year control	0.82 (0.62–1.09)	—	—
Age (years)	55.8 ± 18.6	55.5 ± 19.9	52.0 ± 20.3
Sex (% female)	45.8%	45.3%	44.9%
Duration of diabetes, years	13.0 (6.0–25.0)	7.5 (1.0–16.0)**	13.0 (4.5–23.5)
Recent HbA1c (%)	11.7 (8.8–14.1)	11.0 (8.8–14.9)	11.7 (9.3–13.6)
Severe hypoglycemia			
No. hospitalizations	876	1142	1094
No. hospitalizations per day	9.6	12.7	11.9
Incidence rate ratio (95% CI)			
Compared with inter-year control	0.76 (0.63–0.83)***	—	—
Compared with intra-year control	0.79 (0.72–0.87)***	—	—
Age (years)	74.9 ± 11.7	74.0 ± 12.4	73.7 ± 12.1*
Sex (% female)	50.6%	51.8%	52.7%
Duration of diabetes (years)	19.0 (14.0–26.0)	19.0 (13.0–26.0)	19.0 (12.0–25.0)*
Recent HbA1c (%)	6.8 (6.1–7.8)	7.0 (6.3–7.9)**	6.9 (6.3–7.8)

Data presented as the mean ± standard deviation and median (25–75th percentile) as appropriate. * $P < 0.05$, ** $P < 0.01$, *** $P < 0.001$ in the comparison between study and control periods. CI, confidence interval; HbA1c, glycated hemoglobin.

number of days in that period. The hospitalization rate during the study period was compared with two control periods by Poisson regression analysis, with incidence rate ratios (IRR) computed. Continuous variables were compared using the *t*-test or Mann–Whitney *U*-test as appropriate, whereas categorical variables were compared using the χ^2 -test. All statistical analyses were carried out with IBM® SPSS® version 26 (Armonk, NY, USA).

RESULTS

A total of 1,503 hospitalizations for severe hyperglycemia (including DKA) or hypoglycemia were recorded during the study period (16.5 per day), which was lower than the 2,026 hospitalizations in the inter-year control (22.5 per day; IRR 0.73, 95% confidence interval 0.69–0.78, $P < 0.001$) and 1,968 hospitalizations in the intra-year control (21.4 per day; IRR 0.77, 95% confidence interval 0.72–0.83, $P < 0.001$). Table 1 shows the characteristics of patients admitted for severe hyperglycemia, DKA and severe hypoglycemia during the three periods,

respectively. Hospitalizations were significantly reduced for both severe hyperglycemia (IRR: inter-year 0.66; intra-year 0.71) and severe hypoglycemia (IRR: inter-year 0.76; intra-year 0.79), but not for DKA (Table 1). Similar trends were observed when stratified by sex, age on admission and regions in Hong Kong. Figure 1 shows that the hospitalization rates from October to January were similar between 2019/2020 and 2018/2019. A drastic drop in late January 2020 coincided with the implementation of the Emergency Response Level on 25 January 2020, with a further dip after the surge of confirmed COVID-19 cases in late March 2020.

During the study period, the mean age of all participants admitted was 71.0 ± 14.9 years, and the majority had long-standing type 2 diabetes (median 18.0 years) with median HbA1c 8.0% (64 mmol/mol). Those admitted with severe hyperglycemia during the study period had a longer duration of diabetes than those admitted during the two control periods ($P < 0.001$; Table 1). They also had a higher plasma glucose and HbA1c. For those admitted for severe hypoglycemia, no

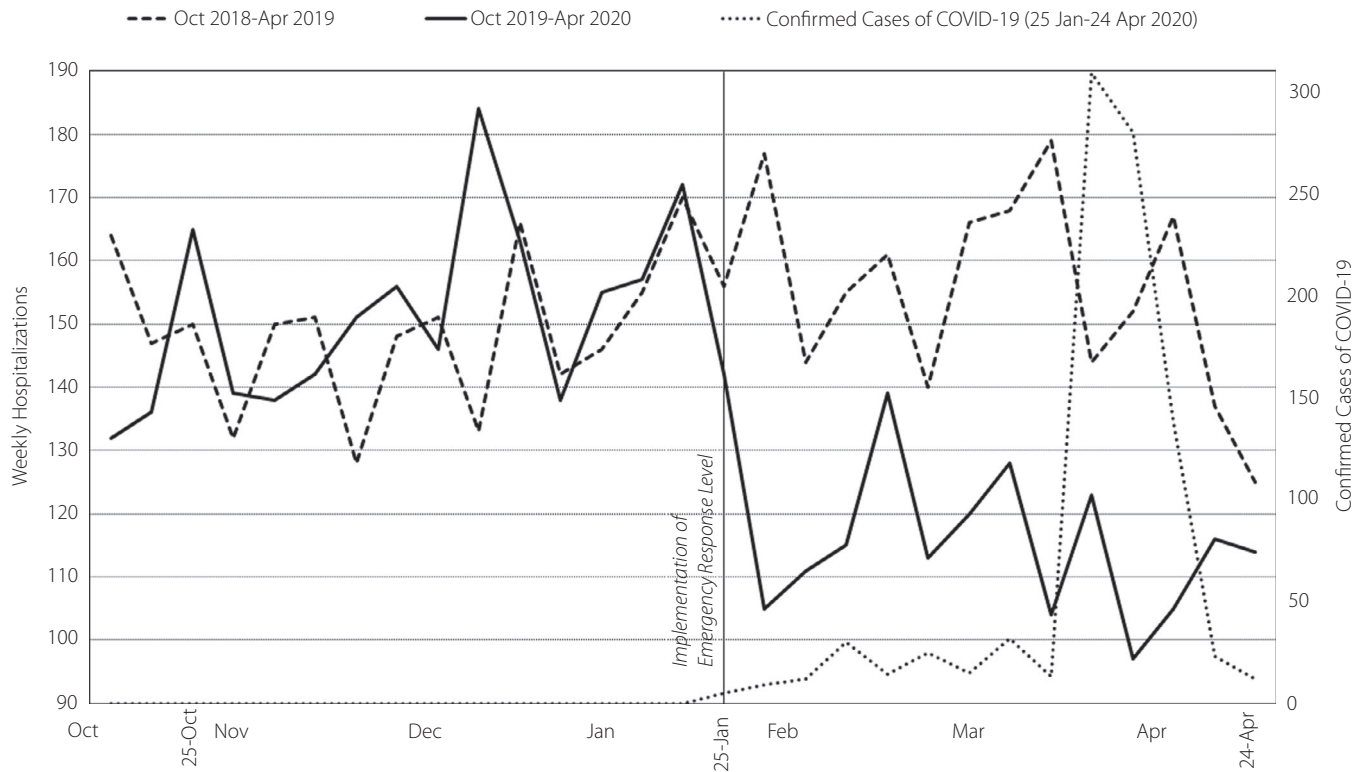


Figure 1 | The weekly hospitalizations for severe hyperglycemia or hypoglycemia in Hong Kong, in relation to the number of confirmed cases of COVID-19.

significant differences were observed in the mean age and duration of diabetes among different periods, except patients admitted during the study period had more complex antidiabetic regimens (18.6% were taking ≥ 3 anti-diabetic agents vs 14.2% and 17.2% inter and intra-year control, respectively). They had lower HbA1c than the inter-year control, but not significantly different from the intra-year control. Fewer patients admitted for severe hypoglycemia during the study period were aged < 65 years (17.0% vs inter-year 20.8%, $P = 0.030$; intra-year 21.0%, $P = 0.025$).

DISCUSSION

In this first territory-wide study, we quantified the impact of the COVID-19 pandemic on diabetes-related acute care. We observed an abrupt drop in hospitalization rates by approximately 25% after the first confirmed local case of COVID-19 in late January, and the reduction was maintained throughout the pandemic period. A similar collateral effect of COVID-19 on other acute conditions, including myocardial infarction^{7,9} and stroke¹⁰, has also been reported. The Department of Veterans Affairs, the largest health system in the USA, has observed a 42% reduction in overall hospitalization rates during the COVID-19 pandemic. The drop in admissions for conditions generally requiring emergency treatment parallels the decrease in overall hospitalization rates¹¹.

In the present study, the reduction in hospitalization rates was mainly in admissions for severe hyperglycemia, but not for DKA. This is presumably because the more pronounced symptoms of DKA would prompt these individuals to attend the A&E¹², whereas those with less marked symptoms of hyperglycemia would try to avoid hospital attendance. Individuals in the severe hyperglycemia group during the study period had significantly higher plasma glucose and HbA1c than those admitted during the control periods, suggesting that many individuals might intentionally delay seeking medical care for fear of exposing themselves to potential COVID-19 infection. This could lead to a delay in treatment, as patients in the severe hyperglycemic group had unacceptably high HbA1c, and they likely required hospitalization for insulin therapy¹³ and exclusion of infections¹⁴. We do not have data on the proportion of patients presenting with newly diagnosed diabetes in the severe hyperglycemic group, and therefore cannot assess the potential impact on delayed diagnosis. A similar trend in the reduction of admissions for severe hypoglycemia was also observed during the study period. The reduction of hospitalization rates was mainly observed in the younger age groups who were more likely to be able to manage their hypoglycemic episodes at home.

The decline in emergency admissions might not be only due to individuals avoiding hospital to minimize the risk of COVID-19 infection¹¹. Interviews with people with diabetes

have suggested that some might be delaying treatment in order not to burden the healthcare system. Concern has been expressed regarding how “sick” one needs to be to call a paramedic, and what can be done if the emergency services are overwhelmed¹⁵. People with chronic disorders, such as diabetes, are faced with a number of difficulties in self-management in the time of the COVID-19 pandemic. They also have to deal with postponement of clinic visits, suspension of treatment for diabetes-related issues, as well as lack of access and/or interruption of medications and supplies.

The present study was limited by its retrospective nature. We relied on the diagnostic codes to capture the hospitalizations, and miscoding or misdiagnosis cannot be ruled out. There might also be underreporting in discharge diagnosis. Furthermore, we did not differentiate between symptomatic hyperglycemia and hyperosmolar hyperglycemic state. The present study was based on the healthcare utilization pattern in Hong Kong, and the results might not be generalizable to other countries. Nevertheless, the present findings should help to raise awareness among endocrinologists to take proactive measures to maintain case detection and optimization of glycemia in those with poorly controlled diabetes who may not be seeking medical attention. With the interruption of routine clinical service, lockdown and restricted access, managing people with diabetes during the COVID-19 pandemic is challenging¹⁶. Approaches with telemedicine and digital medicine can be used to reach out to at-risk individuals with diabetes, and improve the access and efficiency of medical care¹⁷. It remains to be seen how the observed reduction in acute admissions affects the health outcomes of individuals who would otherwise require in-patient care, and whether there will be a subsequent rebound in hospitalization rates after the COVID-19 outbreak.

DISCLOSURE

The authors declare no conflict of interest.

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